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Implementation of a Clinical Pathway Decreases Length of Stay and Cost for Bowel Resection

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Objective
To examine the effect of a clinical pathway for small and large bowel resection on cost and length of hospital stay.

Summary Background Data
Clinical pathways are designed to streamline patient care delivery and maximize efficiency while minimizing cost. Theoretically, they should be most effective in commonly performed procedures, in which volume and familiarity are high.

Methods
A clinical pathway to assist in the management of patients undergoing bowel resection was developed by a multidisciplinary team and implemented. Data about length of stay and cost was collected for all patients undergoing bowel resection 1 year before and 1 year after pathway implementation. Three groups were compared: patients undergoing bowel resection in the year prior to pathway implementation (prepathway), patients in the year after pathway implementation but not included on the pathway (nonpathway), and patients included in the pathway (pathway).

Results
The mean cost per hospital stay was $19,997.35 ± 1244.61 for patients in the prepathway group, $20,835.28 ± 2286.26 for those in the nonpathway group, and $13,908.53 ± 1113.01 for those in the pathway group ($p < 0.05$ vs. other groups). Mean postoperative length of stay was 9.98 ± 0.62 days (prepathway), 9.68 ± 0.88 days for (nonpathway), and 7.71 ± 0.37 days (pathway) ($p < 0.05$ *vs.* other groups).

Conclusions
Implementation of the pathway produced significant decreases in length of stay and cost in the pathway group as compared to the prepathway group. These results support the further development of clinical pathways for general surgical procedures.

Economic pressures and the continuing drive for more cost-effective medical practices are strong motivating forces for the development of clinical pathways. In this environment, clinical pathways are becoming common in all areas of medicine. Clinical pathways were originally adapted from engineering fields, where they are used to increase efficiency and provide a timeline for job completion. Clinical pathways may best be defined as an "optimal sequencing and timing of interventions by physicians, nurses, and other staff for a particular diagnosis or procedure."[1] The goal of a pathway is to provide a high level of care in a cost-effective manner.[2]

Clinical pathways are thought to be especially appropriate for high-cost, high-volume procedures requiring multidisciplinary collaboration.[3] In such a setting, critical examination of each aspect of a patient's care can result in increased coordination and streamlining of care and decreases in cost and length of stay. Clinical pathways should be appropriate for surgical procedures, especially those that are frequently performed. Previous studies have found that clinical pathways can lead to decreases in cost and length of stay in vascular,[4–6] cardiac,[7] urologic,[8] and head and neck procedures.[3,9] A previous study from our institution found that a clinical pathway for ileoanal pull-through patients resulted in decreased length of stay and hospital charges for participating patients.[10]

We sought to develop a clinical pathway to assist in the management of patients undergoing bowel resection. We hypothesized that this pathway could help decrease patient cost and length of stay without increasing morbidity and mortality.

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Table 1. SPECIFICALLY TARGETED AREAS OF PATIENT CARE

Area	Intervention
Length of stay	Earlier discharge planning, nasogastric tube removal, and diet advancement
Nasogastric tube	Criteria for removal standardized
Bowel preparation	Commercially available kit utilized
Antibiotics	Perioperative use changed to 1 preoperative and 3 postoperative doses
Deep vein thrombosis prophylaxis	Subcutaneous heparin only

METHODS

A clinical pathway was designed to assist in the management of patients in DRG 148 and 149 (small and large bowel resection with or without complications). To develop the pathway, a multidisciplinary team consisting of surgeons, residents, nurses, physical therapists, pharmacists, social workers, dietitians, utilization review personnel, operating room personnel, and respiratory therapists was assembled. This team reviewed each aspect of patient care from admission to discharge and identified areas for potential intervention. Timing of care was streamlined wherever possible. When appropriate, the literature was reviewed to determine the most effective and cost efficient way to deliver care.

We identified several areas for specific intervention (Table 1). Any interventions that occurred were the result of agreements by the patient care staff and attending physicians—there were no specific outside influences. Routine preoperative urinalysis and PT/PTT studies were eliminated. Bowel preparation was standardized to a commercially available kit along with oral antibiotics (neomycin and metronidazole). Perioperative antibiotics were standardized to cefazolin and metronidazole (gentamicin and clindamycin if allergic to penicillin), with one dose given preoperatively and three doses postoperatively. Routine deep venous thrombosis prophylaxis with subcutaneous heparin was adopted; compression boots were used only if heparin was contraindicated or in special situations. The rationale for nasogastric (NG) tube use was standardized so that NG tubes were removed when bowel sounds were present and the NG output for the previous 24 hours was less than 1000 cc. Early diet advancement was encouraged. Routine postoperative laboratory testing was minimized. The need for early discharge planning was emphasized.

After goals for a patient's stay were set, a timeline was developed. Because the nursing staff in our institution was already familiar with a 12–focus-area approach (tests, medicines, information, coping, comfort/sleep, nutrition, protective mechanisms, mobility, elimination, reproduction/sexuality/self-perception, ventilation, and circulation), the timeline was developed based on those categories. Ideal events of each day, from preadmission testing to discharge, were charted on the timeline in each of the categories. A portion of a typical day in the timeline is shown in Table 2. The timeline also included goals and suggested criteria to meet them. The timeline was posted in each patient's room so that all those involved in the patient's care (including patients themselves) were able to follow this progression.

Preprinted pre- and postoperative orders in the form of checklists were also developed. These were designed to cover routine aspects of patient care, including bowel preparation, preoperative tests, and perioperative antibiotics, while leaving room for individualized orders.

Before pathway implementation, in-service educational programs were held for attendings, residents, nurses, operating room personnel, and others involved in the care of this group of patients. The concept of clinical pathways and the design and goals of the pathway were reviewed and feedback was obtained. The pathway was implemented after these sessions.

Entry of patients into the pathway was voluntary by decision of the attending surgeon. Patients undergoing ileoanal pull-through procedures were excluded because a separate pathway for their care was already in use, but there were no other exclusion criteria for the pathway. Once a patient was placed in the pathway group, he or she remained in that group regardless of hospital course.

No additional personnel were hired or needed for the development or implementation of our pathway. Once implemented, the pathway was self-administered by the per-

Table 2. EXAMPLE OF PATHWAY TIMELINE

Postop Day 2	
Consults	Visiting nurse coordinator if home care follow-up anticipated.
Tests	Check surgical pathology results.
Meds	SQ heparin q12 hours.
Coping	**Goal:** Patient needs minimal assistance with self-care. Discuss need for visiting nurse. Make arrangements if needed. **For patient with a stoma** **Goal:** Patient participating in self-care of ostomy. Demonstrate pouch change Demonstrate pouch emptying. Have patient return demonstration and begin emptying pouch independently. Assist patient to look at stoma and discuss feelings.
Nutrition	**Goal:** Maintain hydration and electrolyte balance while NPO. IV, electrolyte replacement. NPO.
Mobility	**Goal:** Patient able to ambulate to chair with some assistance. Ambulate TID.

Interventions and goals were placed in the framework of 12 focus areas, of which six are demonstrated here.

Table 3. GROUP COMPOSITION, DEMOGRAPHIC, AND SEVERITY DATA

Group	N	Male:Female	Age (years)	Composition by APR-DRG Severity			
				1	2	3	4
Prepathway	167	78:89	57.1 ± 1.3	10.2	36.5	28.1	24.6
Postpathway	170	74:96	55.7 ± 1.4	14.7	35.9	28.8	20.6
Nonpathway	69	30:39	50.0 ± 2.3*	11.6	29.0	30.4	29.0
Pathway	101	44:57	59.6 ± 1.6	16.8	40.6	27.7	14.9

Age presented as mean ± SEM. There were no gender composition differences by χ^2 analysis. APR-DRG severity data shown as a percentage of patients in each APR-DRG severity subgroup, where patients in group 1 represent the least severely ill and patients in group 4 the most severely ill. There were no statistically significant differences in group composition by APR-DRG severity by χ^2 analysis.
* Statistically significant *vs.* prepathway and pathway groups by ANOVA confirmed by Duncan's test ($p < 0.05$).

sonnel involved in the care of bowel resection patients. No specific individuals were designated to "enforce" the pathway.

Data was collected about length of stay, hospital cost, NG tube removal and replacement, diet advancement, antibiotic use, deep venous thrombosis occurrence, and mortality for all DRG 148 and 149 patients retrospectively for 1 year before and prospectively for 1 year after pathway implementation. To determine severity of illness, the All Patient Refined DRG (APR-DRG) severity scores were determined, resulting in a score of 1 to 4 for each patient, with the higher score indicating a greater severity of illness. Data about readmission within 31 days of hospital discharge was obtained through chart review, with care taken to ensure that follow-up visits were made to our institution and that the patients had not been admitted elsewhere. Cost and illness severity data was supplied by the Decision Support Services of the Health Alliance of Greater Cincinnati, of which the University Hospital is a member. Charge data from 1996 was linked to the appropriate 1995 cost in order to convert all costs to 1995 dollars.

Data analysis was carried out primarily for three groups of patients undergoing bowel resection: (1) patients in the year before pathway implementation (prepathway), (2) patients in the year after pathway implementation but not placed on the pathway (nonpathway), and (3) patients placed on the pathway (pathway). In addition, a fourth group (postpathway), comprised of all patients from the nonpathway and pathway groups, was compared to the prepathway group. Statistical analysis was performed as noted in the results section using a statistical program (SASS release 6.04). Data is presented as mean ± SEM where applicable or as percentages of patients where noted.

RESULTS

There were 167 patients in the prepathway group and 170 patients in the postpathway group. Of postpathway patients, there were 69 patients in the nonpathway group and 101 patients in the pathway group. Patients in the nonpathway group were, on average, younger than the prepathway or pathway patients ($p < 0.05$). Patient demographic and illness severity information is summarized in Table 3. There were no statistically significant differences in group composition in terms of severity of illness as determined by APR-DRG severity scores.

Analysis of group composition by attending surgeon is presented in Table 4. A total of 24 surgeons performed bowel resections in our institution during the period of the study. Of the 19 who performed bowel resections in the year after pathway implementation, 14 placed at least one patient on the pathway.

Data concerning length of stay is presented in Figure 1. Mean total length of stay was significantly less in the postpathway group as compared to the prepathway group ($p < 0.05$). A reduced postoperative length of stay approaching statistical significance was also seen in the postpathway group (8.51 days) as compared to the prepathway group (9.98 days; $p = 0.0525$ by Student *t* test). When the postpathway group was broken down into pathway and nonpathway components, mean postoperative length of stay was significantly less ($p < 0.05$) in the pathway group (7.71 days) as compared to the prepathway (9.98 days) and nonpathway groups (9.68 days). Total length of stay was significantly less for patients in the pathway group (9.41 days) as compared to the prepathway group (12.53 days; $p < 0.05$). There were no significant differences among the groups in length of preoperative stay, although there was a trend toward shorter preoperative hospital stay in the pathway and nonpathway groups compared to the prepathway group.

A portion of the decreased postoperative length of stay

Table 4. PATIENT GROUP COMPOSITION BY ATTENDING PHYSICIAN*

Surgeon	Prepathway	Nonpathway	Pathway
1	27	4	26
2	19	11	17
All others (n = 22)	121	54	58

* Data is shown as numbers of patients in each category.

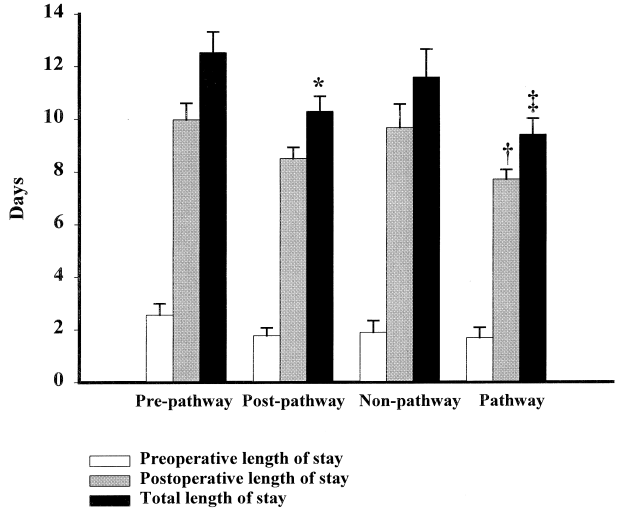

Figure 1. Length of stay by group. Figures are mean hospital days ± SEM. * Statistically significant *vs.* prepathway group by Student *t* test ($p < 0.05$). † Statistically significant *vs.* prepathway and nonpathway groups by ANOVA confirmed by Duncan test ($p < 0.05$). ‡ Statistically significant *vs.* prepathway group by ANOVA confirmed by Duncan test ($p < 0.05$). There were no significant differences in preoperative hospital stay between the groups.

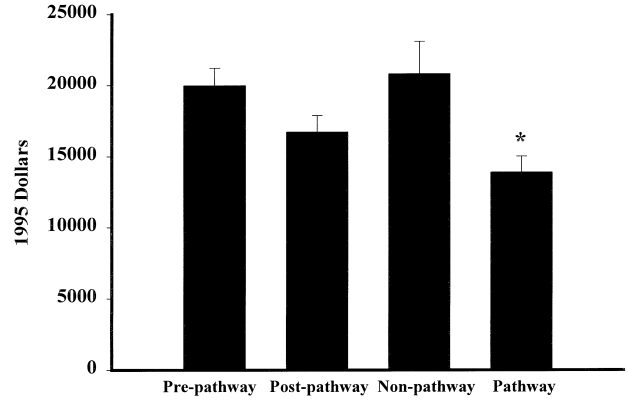

Figure 2. Hospital costs by group. Figures are mean cost ± SEM in 1995 dollars. * Statistically significant *vs.* prepathway and nonpathway groups by ANOVA confirmed by Duncan test ($p < 0.05$). There was no statistically significant difference between prepathway and postpathway groups ($p = 0.055$ by Student *t* test).

may have been attributable to earlier NG tube removal and diet advancement (Table 5). Of these parameters, NG tube removal and advancement to a clear liquid diet occurred significantly earlier in the postpathway group as compared to the prepathway group ($p < 0.05$), and in the pathway group as compared to the prepathway and nonpathway groups ($p < 0.05$). Advancement to a regular diet occurred earlier in the postpathway group as compared to the prepathway group ($p < 0.05$), and in the pathway group as compared to the prepathway group ($p < 0.05$).

We had also hypothesized that costs would be decreased for patients in the pathway group. Total hospital cost data is presented in Figure 2. The mean cost per hospital stay in 1995 dollars was $19997.35 for the prepathway group, $16719.98 for the postpathway group, $20,835.28 for the nonpathway group, and $13908.53 for the pathway group. The mean cost was significantly less for patients in the pathway group than the prepathway or nonpathway groups ($p < 0.05$). The difference in mean hospital cost between the prepathway patients and the postpathway patients approached, but did not meet, statistical significance ($p = 0.055$).

Cost data was analyzed by selected categories such as room, pharmacy, radiology, operating room, and laboratory (Table 6). As could be anticipated from the length-of-stay data, the greatest cost decrease in the pathway group as compared to the prepathway and nonpathway groups occurred in room costs, but there were also significant decreases in pharmacy, laboratory, and radiology costs.

A common criticism of clinical pathways is the potential for a negative impact on patient care. We attempted to assess possible increases in morbidity, especially in areas in which we had intervened. There were no statistically significant differences in our measures of morbidity and mortality between the groups of patients (Table 7). Specifically, when the patients in the pathway group were compared to patients in the prepathway and nonpathway groups, pathway patients had a higher percentage of NG tube replacement than the other two groups, although this was not statistically significant. Standardization of deep venous thrombosis prophylaxis to subcutaneous heparin in the pathway group did not result in an increase in patients diagnosed with venous thrombosis. Standardization of bowel preparation and of perioperative antibiotics to three postoperative doses did not result in a higher percentage of patients who required reinitiation of parenteral antibiotics postoperatively for infectious complications. There were no increases in hospital readmissions or mortality in the pathway group as compared to the other two groups. Taken together, these data indicate that there was no increase in morbidity or mortality in the pathway group.

Table 5. NASOGASTRIC TUBE REMOVAL AND DIET ADVANCEMENT BY GROUP

Group	NG D/C	CLD	Regular Diet
Prepathway	3.70 ± 0.23	5.56 ± 0.31	7.17 ± 0.38
Postpathway	3.06 ± 0.12*	4.41 ± 0.20*	5.65 ± 0.22*
Nonpathway	3.58 ± 0.30	5.08 ± 0.42	6.16 ± 0.47
Pathway	2.81 ± 0.15†	3.99 ± 0.17†	5.32 ± 0.19‡

Figures are mean postoperative day ± SEM.
* Statistically significant *vs.* prepathway by Student *t* test ($p < 0.05$).
† Statistically significant *vs.* nonpathway and prepathway groups by ANOVA confirmed by Duncan's test ($p < 0.05$).
‡ Statistically significant *vs.* prepathway group by ANOVA confirmed by Duncan's test ($p < 0.05$).
NG D/C, nasogastric tube removal; CLD, clear liquid diet.

Table 6. MEAN COSTS BY GROUP FOR SELECTED COST CATEGORIES

	Prepathway	Postpathway	Nonpathway	Pathway
Room	8410.79 ± 590.95	7175.02 ± 546.07	9060.98 ± 1110.95	5886.59 ± 483.72*
Pharmacy	3720.63 ± 321.31	2923.67 ± 346.66	3904.98 ± 654.95	2253.27 ± 362.61*
Laboratory	1853.60 ± 169.66	1411.58 ± 153.33	1999.35 ± 302.27	1010.03 ± 143.03*
Radiology	741.77 ± 83.41	665.07 ± 90.80	1098.21 ± 186.41	369.16 ± 71.77*
Respiratory	453.50 ± 79.89	386.66 ± 72.55	612.81 ± 148.3	232.16 ± 64.44†

Figures are mean ± SEM in 1995 dollars.
* Statistically significant *vs.* prepathway and nonpathway groups by ANOVA confirmed by Duncan's test ($p < 0.05$).
† Statistically significant *vs.* nonpathway only by ANOVA confirmed by Duncan's test ($p < 0.05$).

DISCUSSION

In this study, we report our experiences with the development and implementation of a clinical pathway to aid in the care of patients undergoing small and large bowel resection. Cost and postoperative length of stay were decreased in patients in the pathway group as compared to the prepathway and nonpathway groups. This decrease in cost was multifactorial, although it appeared to be at least partially a function of the decreased length of stay. There was no increase in morbidity or mortality in the pathway patients as compared to the other groups.

Although we were primarily interested in comparing the prepathway patients to the pathway patients, the nonpathway group of patients was included to provide a contemporaneous group of patients to compare to the pathway group, because we recognize that surgical practices change over time—even over the course of a year. As expected, decreases in cost and length of stay were seen in the pathway group as compared to the prepathway group. There was also a trend toward decreased length of stay, mean postoperative day of NG tube removal, and diet advancement in the nonpathway group as compared to the prepathway group. This may be a collateral effect of pathway implementation, as it is likely that the process of clinical pathway development and implementation leads to modifications of clinical practices that are not confined to treatment of pathway patients. Thus, the impact of a clinical pathway for a given procedure is probably not solely limited to those patients on the pathway.

Our mean length of stay is longer than many lengths of stays reported in the literature; we believe that various aspects of our patient population contribute to this. Our hospital serves a large indigent population, which may increase the difficulty of discharge planning and delay dismissal from the hospital. One of the goals of our pathway was to initiate earlier discharge planning, with the goal of decreasing length of stay. Our pathway is also not restricted to only low-risk patients or patients undergoing elective operations. Any patient undergoing bowel resection was eligible for placement on the pathway, including those suffering multisystem trauma. We feel that the benefits of the pathway process may extend to all patients in a given group, not simply those viewed as low operative risk.

Placement of patients on the DRG 148 and 149 pathway occurred either preoperatively or at the time of operation. Analysis of pathway patient entry by surgeon revealed that two surgeons accounted for 43% of the pathway patients. These surgeons were members of the pathway committee and were probably more familiar with the pathway process than other surgeons. There were various reasons why other participating surgeons did not place more patients on the pathway: in some instances, the preprinted forms were not readily available; in others, there appeared to be a lack of understanding on behalf of attending and resident staff that every patient undergoing bowel resection was eligible for placement on the pathway, regardless of diagnosis or other circumstances. We are attempting to resolve these issues with ongoing education.

This is not a prospective randomized controlled study; such a study involving a large number of patients in a single institution would be very difficult to perform. Because the same patient care teams (surgeons, residents, and nurses)

Table 7. MORBIDITY AND MORTALITY DATA BY GROUP*

	Prepathway	Postpathway	Nonpathway	Pathway
NG replacement	12.30	11.76	5.41	14.63
DVT occurrence	2.63	3.1	4.69	2.02
IV antibiotics	18.83	15.95	20.31	13.13
Readmissions	11.76	17.61	22.58	14.43
Mortality	6.59	3.53	5.80	1.98

* Figures are percentages of patients in each group. There were no differences between groups in each category by χ^2 analysis.

would care for both groups of patients, modification of patient care practices would be impossible to restrict to a single group. In a previous prospective study of a pathway from our institution, monitoring of the control group (n = 10) was carried out surreptitiously prior to the announcement of the pathway's existence in order to avoid influencing patient care.[10]

Although the original adaptation of pathways to the clinical setting was directed at the development of coordinated nursing plans for postoperative patients,[11] by incorporating physicians into pathway design, differences in physician preferences can be resolved so that other caregivers can be prepared to deliver care.[10] In our institution, the development of clinical pathways has become a truly multidisciplinary process, involving representatives from all facets of patient care. In this manner, pathways empower hospital staff and give them a common action plan from which to view and understand their various roles in the overall care process.[12]

An important aspect of clinical pathway development is that the resulting pathways are specific for each institution, representing local variances in resources and practice. In an era where outside interests may set guidelines for patient care that are unreasonable, clinical pathways may represent a middle ground, where cost savings may be realized but the guidelines reflect the true clinical progression of surgical illness at a particular institution.[13]

A clinical pathway, once implemented, should not remain a static entity. Intermittent review and revision is needed to ensure that it remains relevant to current practice. One example is the use of NG tubes. At the time that our pathway was developed, NG tubes were commonly left in place for an extended period of time. The guidelines for NG tube use developed for our pathway represent compromises reached by attending physicians. Recent studies have indicated that there appears to be no advantage to NG tube use under certain conditions.[14] Experiences in our institution have been consistent with these reports. As a result, many of the surgeons in our institution no longer routinely use NG tubes, and others are using them for much shorter periods of time. Future versions of our pathway will reflect these changes. Further study will be needed to evaluate the impact of continued evolution in patient care on cost and length of stay.

We have found that clinical pathways can serve as educational tools. The pathways provide a visual overview of a patient's care. The timeline is posted in each room, and each involved individual, including the patients themselves, can see specific outcomes and goals. This appears to increase patient and staff education, interest, and participation in care. As was seen with our previous pathway experience, one cannot determine if the pathway itself led to the decreases in cost and length of stay seen in this study or if these effects were due to scrutiny of aspects of care and patient and staff education. Either way, the benefits are worthwhile.[10]

In summary, the implementation of a clinical pathway for patients undergoing bowel resection produced significant decreases in length of stay and cost in participating patients. The cost decrease appeared to be at least partially a function of length of stay, but was multifactorial. There appeared to be no increase in morbidity or mortality in the pathway patients as compared to other groups. These results support further development of clinical pathways for surgical procedures.

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